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ON GAUSS'S METHOD OF ELIMINATION.

By Prof. Asaph Hall, Georgetown, D. C.

In the original normal equations the diagonal coefficients are positive, being the sums of squares. By Gauss's method of elimination the diagonal coefficients of the first reduced normals are $[bb\,.\,1]$, $[cc\,.\,1]$, etc., and we might infer from symmetry that these also are positive; this may be shown as follows:

$$[bb\,.\,1] = [bb] - \frac{[ab]^2}{[aa]} = \frac{[aa]\,.\,[bb] - [ab]^2}{[aa]}\,.$$

Let μ = number of equations of condition $= 2$; the numerator becomes

$$(a_1^2 + a_2^2)\,(b_1^2 + b_2^2) - (a_1b_1 + a_2b_2)^2 = (a_1b_2 - a_2b_1)^2\,.$$

Let $\mu = 3$.

$$(a_1^2 + a_2^2 + a_3^2)\,(b_1^2 + b_2^2 + b_3^2) - (a_1b_1 + a_2b_2 + a_3b_3)^2$$
$$= (a_1b_2 - a_2b_1)^2 + (a_1b_3 - a_3b_1)^2 + (a_2b_3 - a_3b_2)^2\,.$$

Let $\mu = 4$, and the numerator is

$$(a_1b_2 - a_2b_1)^2 + (a_1b_3 - a_3b_1)^2 + (a_1b_4 - a_4b_1)^2 + (a_2b_3 - a_3b_2)^2$$
$$+ (a_2b_4 - a_4b_2)^2 + (a_3b_4 - a_4b_3)^2\,.$$

This process can be continued, and for μ = a whole number the numerator will reduce to a sum of squares. Hence the value of $[bb\,.\,1]$ is positive, and of course the similar coefficients in the first, second, third, etc., reduced normals are positive. The reduction is symmetrical, and for a given value of μ we can infer the number of squares of determinants of the second order which will form the numerator. See ANNALS OF MATHEMATICS, Vol. VII, p. 65.

EXERCISE.

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A HEMISPHERICAL bowl, external and internal radii R and r, has a sphere of the same material, radius a, suspended from the edge of the rim. Determine the inclination of the bowl to the horizontal plane on which it stands.

[*Artemas Martin.*]